Understanding
ANIMAL RESEARCH

WHERE DO MEDICINES COME FROM?

Understanding Animal Research aims to achieve broad understanding and acceptance of humane animal research in the UK to advance science and medicine.

Understanding Animal Research engages with the public and provides evidence-based information about how and why animals are used in research.

Understanding Animal Research has also developed the Concordat on Openness on Animal Research in the UK. This commits its signatories to being more open about why and how they use animals in research.

Understanding Animal Research has more than 100 organisational members as well as individual supporters. Member organisations include universities, pharmaceutical companies, medical research charities, research funders, contract research organisations, professional and learned societies, and trade unions.

Understanding
ANIMAL RESEARCH

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When we get sick – whether it's with a cold or something more serious like a heart attack – most of us expect that there will be a medicine to help us get better.

Whether you want to know how researchers develop new medicines or why this process can take a long time, this booklet aims to answer your questions about where medicines come from.

UNDERSTANDING OUR BODIES

Scientists need to understand how the body works when it is healthy and what happens when something goes wrong. The study of different chemicals and how they work tells scientists, doctors, nurses, and pharmacists what a medicine will do and which one is best for our illness.

In 1940 eight mice were injected with a lethal dose of bacteria. Four mice given penicillin survived while the others all died.

By 1942, penicillin was being used to save dying patients. Just three years later, penicillin was being produced on an industrial scale and a Nobel Prize was given for its discovery and development.

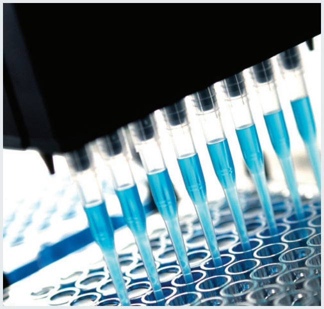
During World War II, penicillin dramatically reduced the number of amputations and deaths resulting from infected wounds.

Life-enhancing medical advances have come from centuries of research on chemicals, cells, animals and the human body. The living body contains hundreds of billions of cells and is very complex, so there is still a lot we don't know. Even today it can take decades to develop a new and effective medicine or vaccine.

Studies taking place in many research laboratories–both academic and commercial –are looking at new ways to understand diseases like cancer, Alzheimer's disease and asthma. The carefully regulated use of animals is a key part of this.

Finding new treatments

It can take a decade or more to get from identifying a potential new medicine to the point when your doctor or nurse can prescribe it. When trying to find solutions to medical problems, scientists use many different types of research, including animal studies. This process reduces hundreds of thousands of possible new medicines to the handful that have a chance of being successful.

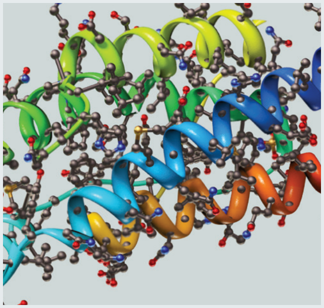


Researchers find new medicines in many different places. The search can start with natural chemicals such as plant extracts, genes, or antibodies.

Thousands of new chemicals can be modelled by computer and made in small quantities.

Whatever the source, potential treatments are mass-screened against their targets to see if they are effective.

Potential treatments that show promise may then go on to be tested in animals.



Research into new medicines is a lengthy and costly process. It involves the combined efforts of pharmaceutical and biotechnology companies, universities, charities, research institutes, hospitals and government.

HOW DOES IT WORK?

Based on research to understand how our bodies work in sickness and in health, scientists first identify a 'target' in the body (often a protein) where a new medicine should work. They then study the target in cells, tissues, animals and human samples and look at a range of things that may affect it. These can include plant extracts, chemicals, genes and antibodies. Scientists often use computer modelling to see how the chemical may 'fit' the target, like a key in a lock.

Millions of chemical combin-ations may be studied, but only a fraction of potential treatments make it to the next stage.

Where do medicines come from?

THE MAKING OF A MEDICINE

RESEARCH
Understanding our bodies in health and illness.

FINDING NEW TREATMENTS
Identifying new targets, developing and screening treatments.

NARROWING THE FIELD
Focusing on efficacy, safety and dose selection.

Narrowing the field

Having established which chemicals may work, scientists still need to narrow the field to get closer to creating a new medicine. First they will study the effect of the potential treatment on cells and tissues from animals or humans.

Even after combining all this knowledge, scientists cannot fully predict how the body's cells and organs will interact with each other and with a new chemical. For example, a medicine you swallow may be altered by the digestive system before reaching its target.

Animals are important at this stage because researchers need to know how the medicine passes through the body and what dose is needed as well as learning about possible side effects.

Looking for side effects is the final part of narrowing the field and at this point animal research is required by law before potential new medicines and vaccines can be given to human volunteers.

This part of the process is known as safety testing.

Most of the animals used are rats or mice, but generally the law requires that two species are used so some non-rodents (dogs, pigs or monkeys) will also be needed.

As with other areas of animal research, safety testing is strictly regulated.

More information about why and how animals are used in research and testing can be found at the end of this booklet.

CLINICAL TRIALS

PHASE 1
Safety, dose and how it works in volunteers (20–100 usually healthy volunteers). Short trial. Low doses.

PHASE 2
Does it work in patients? (100–500 volunteer patients). Longer trial. Larger doses.

PHASE 3
Getting evidence in larger populations (1,000–5,000 volunteer patients assigned randomly to groups). Compare the new treatment with existing treatments or a placebo.

Where do medicines come from?

APPROVAL
Medicine licensed.

PHASE 4
LIFE OF A MEDICINE
Continuous monitoring and maintaining safety oversight.

Clinical trials

Hundreds of thousands of substances have now been narrowed down to a few potential medicines by computer modelling and studies using chemicals, cells and animals. At this stage, doctors test potential medicines on people in clinical trials.

Each clinical trial follows a set of rules (a protocol) and is closely monitored by doctors. Safety committees, hospital ethics committees and the official regulator, the Medicines and Healthcare products Regulatory Agency (MHRA), are responsible for the strict regulation and review of these trials.

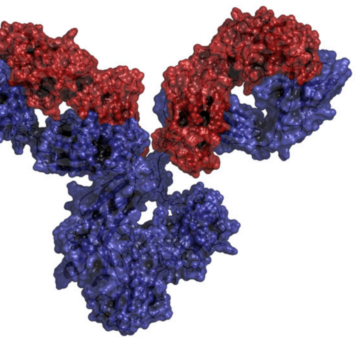
THE DIFFERENT PHASES

There are four phases of clinical trials: three take place before a medicine receives its licence; one after it is available for prescription. Clinical trials check whether the medicine works in humans: is it an improvement on current treatments, is it safe, how should it be given and at what dose?

The final stages

Clinical trials can be stopped at any stage, and sometimes scientists need to go back to animal or tissue tests to refine a treatment. But if Phase 3 results show the medicine is effective, safety regulators then decide whether it can be licensed and prescribed. Usually a new medicine is licensed by the Medicines and Healthcare products Regulatory Authority (MHRA) or the European Medicines Agency (EMA).

Even after a licence is received, the clinical trial process continues with Phase 4 monitoring.



Thanks to many years of research in mice, antibody and stem cell treatments are starting to appear.

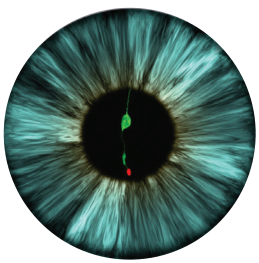
These new 'biological treatments' are used to treat cancer, diabetes and arthritis and are showing promise for heart failure, spinal injury and other conditions.

LOOKING TO THE FUTURE

As understanding grows, scientists and doctors will find new treatments and cures for diseases.

Today's research is likely to lead to more new 'biological' as well as conventional chemical treatments. Biological medicines include antibodies, proteins, stem cell treatments and gene therapies.

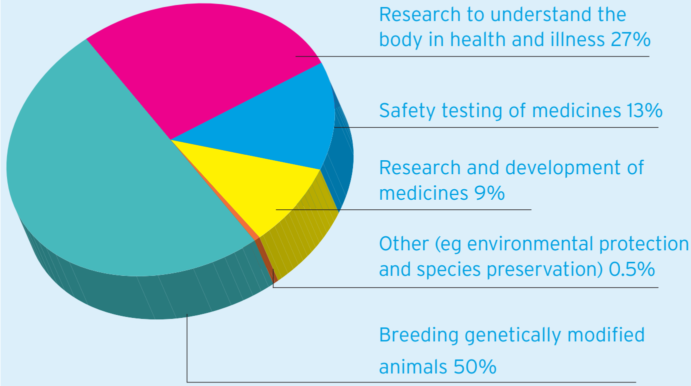
Even as you are reading this booklet, research is going on around the world to find better ways of treating illness and disease. Thanks to research like this, people are living longer and better lives.



Retinal stem cell transplants have restored sight in mice and are being tried in patients.

Why are animals used?

HOW ANIMALS ARE USED IN RESEARCH



Animals are a very important part of the research process and the development of a new medicine. They are studied for four main reasons. *(See diagram above).*

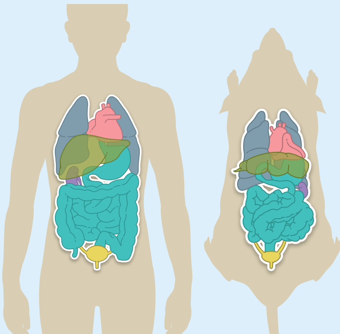
Although animals seem very different from us, their biology is often very similar. This is why animals can be used to understand our bodies in health and disease and to help predict whether medicines are likely to work and be safe.

Most of the animals used for research and testing are mice, rats, fish and birds. But a small number of larger animals, such as pigs, dogs and monkeys, are also studied. Increasingly, mice are genetically modified to mimic the human condition even more closely.

Sometimes the response to a medicine in people is not the same as in animals. This does not mean the studies have failed–they can give important clues for further research. Differences can also be seen between people who take the same medicine. For example, Herceptin, which is a biological treatment based on a mouse antibody, only works for some women with certain types of breast cancer.

Scientists, universities, companies and government work to use as few animals as possible. Advances in science mean there are now many 'alternatives' to animal research, which include the use of computer, chemical, cell, tissue, organ and human studies. It is illegal to use an animal if there is any other way of doing the research.

But even with the latest technology, animal studies are still important to medical progress.



BIOLOGICAL SIMILARITY
The body plan of different mammals is so similar that research on mice helps us to understand how the human body works.

GM mice can often mimic human illness even better.

Animal research has contributed to life-saving treatments and improved the quality of our lives. Antibiotics, vaccines, treatments for diabetes, cancer and asthma, and the promise of stem cells for the diseases of old age are all based, in part, on research using animals.

How are animals used?

There are tough rules that govern the use of animals in research. Three separate licences are needed: a personal licence for the researcher a project licence for the study and an establishment licence for the place where the research is done. Government vets and doctors make regular, and often unannounced, visits to make sure that the animals are properly looked after. On their recommendation, licences can be removed and facilities closed down if rules are broken.

Animals have played a vital role in treating asthma. Frog research in the 1920s showed that nerves release chemicals which control muscles. Excessive muscle contraction can give rise to asthma symptoms.

Almost without exception, animals are specially bred for use in research and testing. Many studies cause little suffering. Typically, trained researchers give an animal doses of a potential medicine and then take small blood samples or scan the animal to check painlessly inside its body. Technologists and vets are on hand to look for the smallest signs of pain or distress.

In the 1960s, guinea pig studies showed that asthmatic lungs are inflamed. This led to steroid inhalers.

At the end of most studies, the animals are humanely killed. Full examination of their tissues shows the effect of the treatment.

To minimise the use of animals, the UK has developed a world-leading organisation called the National Centre for Replacement, Refinement and Reduction of Animals in Research (NC3Rs). It works with scientists to help reduce reliance on animals and to improve animal welfare.

Because infections can trigger asthma attacks, mice that can catch a cold are now used to research new asthma treatments. Artificial lungs, such as the 'lung-on-a-chip' are also being developed to test new treatments.